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Quality Attributes Assessment of Minced Green Fig as an Innovative Food Product

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ABSTRACT

In the present research, the quality attributes of minced green fig were estimated. Pickled onion and pickled lemon were added to minced green fig with 5, 10 and 15%, a control sample was prepared from minced green fig without any additive. Minced green samples were analyzed for chemical composition, color, acid value, consistency, total phenol content, antioxidant activity and sensory evaluation. The results showed that, using pickled onion and pickled lemon enhanced ash content, while the ether extract content significantly decreased among all MFO and MFL samples when compared with control sample. The highest crude fiber content was observed with MFL15 sample (2.73%). The highest total carbohydrate content was observed with MFO15 sample (8.88%). Also, adding pickled onion and pickled lemon reinforced total phenol content and subsequently antioxidant activity, balanced acid value. Color was acceptable for all minced green fig samples, where the highest overall acceptability was observed with the MFL samples followed by MFO samples.

Keywords: Green fig, Innovation, Lemon, Onion, Pickles, Quality characteristics.

1. Introduction

Recent developments in the manufacture of food products with good nutritional and sensory quality are among the important goals in order to improve human life, as well as, ensuring the availability of food for the entire population by providing of non-traditional food products that meet the needs of the population. So, according to the global needs of the food and nutritional security, innovate of new food products enhance the food productivity and human needs (Dayan *et al.,* 2009). Innovated food products can reduce crops post-harvest losses by increasing their shelf life, quality, diversity, utilization in the off season both in large scale or home scale (Reddy *et al.*, 2015).

Fig (*Ficus carica* L.) belongs to family Moraceae. It is originated from Western Asia and spread to the Mediterranean. Fig fruit is consisting of fleshy receptacle with a narrow fenestration at the tip and contain sweet crunchy seeds. Fig fruits are perishable, sensitive to microbial spoilage (Stover *et al.,* 2007, Karabulut *et al.,* 2009).

Fig is a very nutritive and healthy food, highly rich in phytonutrients, antioxidants, vitamins and minerals as a natural health benefit source. Fig contains essential amino acids and is rich in vitamins A, B1, B2 and C as well as minerals (Doymaz, 2005 and Ersoy *et al.,* 2015). It also has many medicinal properties such as reducing risk of chronic diseases, protect of skin infections, regulates blood pressure, cancer prevention and manages diabetes (Lansky *et al.,* 2008). Fig fruits always consumed in fresh, dried state, jam, as part of various foods such as cakes, pies, puddings, bakery products. Recently, figs are used in sauces, meat dishes, sliced on pizza and salads (Veberic and Mikulic-Petkovsek, 2016).

Due to the limited knowledge concerning about unripe green fig fruits (dropping fruit) therefore this study aims to assess the quality attributes of minced green fig as an innovative food product, also, estimate the effect of adding pickled onion and pickled lemon on minced green fig quality.

2. Materials and Methods

Unripe green fig fruits were obtained from the farm of faculty of Environmental Science and Agriculture, Matrouh University, Fouka, Matrouh Governorate, Egypt. Pickled onion and pickled

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lemon, salt and olive oil used in the manufacture of minced green fig were purchased from local markets in Cairo, Egypt.

2.1. Preparation of minced green fig:

The green fig fruits were directly collected and brought to the laboratory. Fig fruits were washed and blanched in boiling water at 100°C for 2 min., then rinsing and cooling by tap water to room temperature, then boiled green fig fruits were placed directly in brine (10% NaCl) for one month at room temperature. The pickled green fig fruits were then minced in a blender to reach the correct texture, virgin olive oil (50 g of virgin olive oil/kg of pickled fig fruits) was added during the blending (Escudero-Gilete *et al.,* 2009).

Minced green fig with pickled onion (MFO) and minced green fig with pickled lemon (MFL) samples were prepared by adding pickled onion and pickled lemon to the minced green fig with 5%, 10% and 15% during blending. The different percentage of pickled onion and pickled lemon were minced with green fig. The obtained minced green fig samples were then put into small cleaned glass jars. A control sample of minced green fig (MFC) was processed without adding pickled onion or pickled lemon. All samples were thermally treated for 121°C, 30 minutes and then kept in a refrigerator at 4°C until analysis.

2.2. Chemical composition of minced green fig samples:

Moisture, total ash, ether extract, crude protein and crude fiber contents were determined in all samples, according to the methods described in the A.O.A.C. (2005). The carbohydrate contents were calculated by difference.

2.3. Color determination of minced green fig samples:

Color of minced green samples were measured by using Chroma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer at Cairo University Research Park (CURP), Faculty of Agriculture, Cairo University. Color was expressed using the CIE L^*, a^*, and b^* color system (CIE, 1976). A total of three spectral readings were taken for each sample. Lightness (L^*) (dark to light), the redness (a^*) values (reddish to greenish) and the yellowness (b^*) value (yellowish to bluish) were evaluated.

2.4. Acid value determination of minced green fig samples:

Acid value of minced green fig samples determined by directly titrating the oil/fat in an alcoholic medium against standard potassium hydroxide solution in the presence of phenolphthalein as an indicator, according to Low and Ng (1987).

2.5. Consistency determination of minced green fig samples:

Consistency of minced green fig samples were measured using viscometer, V60002, FFUNGILAB, Spain (Spindle R7) 100 rpm, torque was maintained at 100% at the Food Safety and Quality Control laboratory (FSQC) Faculty of Agriculture, Cairo University.

2.6. Total phenolic compounds determination of minced green fig samples:

Total phenolic compounds were determined colorimetry by Folin–Ciocalteu reagent according to Singleton and Lamuela-Raventos, (1999). Total phenolic compounds content was calculated from the regression equation of the standard plot (y=1001.4x+4.7333, r2=0.9993) and were expressed as mg gallic acid equivalent / Kg sample.

2.7. Antioxidant activity determination of minced green fig samples:

DPPH radical scavenging activity was used to determine the antioxidant activity according to Brand-Williams *et al.,* (1995). Concentration of 20 mg/ml were prepared with methanol from each sample. The extract (100µl) and DPPH radical (100 µl, 0.2 mM) was dissolved in methanol. The mixture was stirred and left to stand for 15 minutes in dark then the absorbance was measured at 517 nm against

a control which carried out using 2 mL DPPH solution without the tested sample. The DPPH free radical scavenging ability was subsequently calculated as follows:

$$\text{DPPH scavenging ability (\%)} = (Ac - At)/Ac \times 100.$$

Where Ac: absorbance of control.
At: absorbance of samples.

2.8. Sensory evaluation of minced green fig samples:

Color, texture, taste, flavor and overall acceptability were evaluated for minced green fig samples. Each of these attributes was rated on a hedonic scale ranging from 1 to 10, where the number 1 corresponded to less pleasurable, 5 corresponded to middle pleasurable and 10 corresponded to very pleasurable according to Guine *et al.,* (2016).

2.9. Statistical Analysis:

The data obtained were subjected to statistical analysis of variance (ANOVA). All analyses were performed in triplicate. All tests were conducted at the 5% significant level according to Armonk, (2011).

3. Results and Discussion

3.1. Chemical composition of minced green fig samples:

Minced green fig samples were chemically analyzed. Results presented in table (1) showed that moisture content significantly increased in both MFO and MFL samples. Ash content had the same trend as moisture content, where adding pickled onion and pickled lemon to minced green fig increased ash content. The highest ash values were observed in the MFO samples which was 5.03%, 5.08% and 5.13% for MFO5, MFO10 and MFO15 samples, followed by MFL samples where the ash content was 4.56%, 4.63% and 4.67% for MFL5, MFL10 and MFL15, respectively. So, the reported ash contents make the MFO and MFL a good source of mineral content.

On the other hands, there was a decrement in ether extract contents, with significant differences among samples. The highest decrement in ether extract content was observed with the MFO samples, where the ether extract contents decrease as the percent of pickled onion increased. For the MFL samples there was no significant difference in ether extract content between the MFL5 samples and the MFC samples. There was a significant decrement observed with both MFL10 and MFL15 samples. Also, it was noticed that, the decrement rate that found with the MFL10 and MFL15 samples were significantly lower than those found with the MFO samples.

As shown in the table (1), for crude protein content, there was a slightly significant decrement in crude protein content for all MFO and MFL samples as compared with MFC sample. Crude fiber content, no significant difference was observed in crude fiber content, but it was noticed that adding pickled onion and pickled lemon with 10% and 15% slightly improved the crude fiber content, where the highest crude fiber values was observed with the MFL15 sample (2.73%), followed by MFL10 and MFO15 with same value (2.43%) then the MFO10 samples (2.33%).

Data in table (1) showed also the total carbohydrate content, where adding pickled onion to minced green fig significantly enhanced the total carbohydrate content. The highest total carbohydrate values observed with MFO15 sample (8.88%) followed by MFO10 sample (4.44%) and MFO5 sample (3.88%) as compared with MFC sample (3.52%), Whilst a high decrement rate in total carbohydrate values was recorded with MFL samples as compared with MFC sample.

Variation in total carbohydrate content may be due to the effect of thermal food process as mentioned by Leong *et al.,* (2019). Dinkecha and Muniye, (2017) reported that onion is rich in ash, fiber and carbohydrate contents, where Eshra *et al.,* (2020) and Janati *et al.,* (2012) found that lemon peel is a good source of ether extract, ash and crude fiber. Krishnamurthy *et al.,* (2012) mentioned that high amount of crude fiber enhanced protection against constipation and prevents cardiovascular disease.

Table 1: Chemical composition of minced green fig samples.

Minced green fig samples	Chemical composition (%)					
	Moisture content	Ash content	Ether extract	Crude protein	Crude fibers	Total carbohydrates
MFC	74.32^{c}±0.36	4.22^{b}±0.19	13.99^{a}±0.24	1.65^{a}±0.42	2.30^{a}±0.34	3.52^{c}±0.54
MFO5	77.53^{a}±0.40	5.03^{a}±0.46	10.06^{c}±0.23	1.34^{a}±0.26	2.16^{a}±0.13	3.88^{c}±0.36
MFO10	78.00^{a}±0.57	5.08^{a}±0.24	9.04^{c}±0.46	1.11^{b}±0.15	2.33^{a}±0.46	4.44^{b}±0.43
MFO15	74.61^{b}±1.15	5.13^{a}±0.46	7.70^{d}±0.51	1.25^{b}±0.21	2.43^{a}±0.80	8.88^{a}±0.20
MFL5	75.73^{b}±0.47	4.56^{b}±0.23	13.82^{a}±0.31	1.36^{a}±0.23	2.20^{a}±0.34	2.33^{e}±0.25
MFL10	77.80^{a}±0.34	4.63^{b}±0.11	12.10^{b}±0.69	1.28^{b}±0.19	2.43^{a}±0.80	2.49^{d}±0.42
MFL15	77.28^{a}±0.41	4.57^{b}±0.57	11.73^{b}±0.46	1.16^{b}±0.23	2.73^{a}±0.46	2.53^{d}±0.41

(MFC) control minced green fig, (MFO5) minced green fig with 5% pickled onion, ((MFO10) minced green fig with 10% pickled onion, (MFO15) minced green fig with 15% pickled onion, (MFL5) minced green fig with 5% pickled lemon, (MFL10) minced green fig with 10% pickled lemon, (MFL15) minced green fig with 15% pickled lemon. Mean value ± Standard deviation of three replicates, means sharing the same letter in the same column are not significantly different at p ≥0.05.

3.2. Color of minced green fig samples:

Color of the food is the first parameter of quality evaluated by consumers even before being consumed. the CIE *L**, *a** and *b** color space, is the most frequently used for the food color detection due to its uniform color distribution and because its perception of color is closest to the one human eye (Du and Sun, 2004 and Hatcher *et al.*, 2004). *L** value represent lightness, while *a** value indicate red to green color and b* value, as a* and b* values increase as the color saturation also increases (Babu *et al.*, 2021). The color values of MF samples were clarified in table (2).

As seen in table (2), there were a slightly significant differences in the a* values for the MF samples. For the *L* *values, there was no significant difference in the *L** values for MFC, MFO5, MFO10 and MFL10 samples. The highest *L* * value was obtained with the MFO5 sample where the lowest *L* * value obtained with the MFL5 sample. With regard to *b** values, there was a highly significant increment in *b* * values for MFO and MFL samples when compared to the MFC sample. According to *L**, *a** and *b* * values, it can be concluded that, the color of MF samples tends to be green-yellowish.

Table 2: Color values of minced green fig samples.

Minced green fig samples	Color parameters		
	L*	***a****	***b****
MFC	46.61^{a}±0.25	5.53^{b}±0.22	13.09^{e}±0.67
MFO5	46.66^{a}±0.47	5.73^{b}±0.13	19.54^{b}±0.13
MFO10	46.42^{a}±0.03	5.47^{c}±0.05	21.15^{a}±0.03
MFO15	45.17^{b}±0.37	5.58^{b}±0.02	17.77^{c}±0.43
MFL5	42.96^{c}±0.42	6.07^{a}±0.10	17.53^{d}±0.26
MFL10	46.53^{a}±0.04	5.47^{c}±0.01	19.24^{b}±0.04
MFL15	44.76^{b}±0.08	5.53^{b}±0.02	18.26^{c}±0.01

(MFC) control minced green fig, (MFO5) minced green fig with 5% pickled onion, ((MFO10) minced green fig with 10% pickled onion, (MFO15) minced green fig with 15% pickled onion, (MFL5) minced green fig with 5% pickled lemon, (MFL10) minced green fig with 10% pickled lemon, (MFL15) minced green fig with 15% pickled lemon. Mean value ± Standard deviation of three replicates, means sharing the same letter in the same column are not significantly different at p≥0.05.

6.3. Acid values of minced green fig samples:

Organic acids are the main contributor to acidity in fruits and vegetables and present in higher levels, which is required for metabolic pathways. Loss of acidity occurs during maturation and ripening is often because of the fact that these acids act as substrate for respiration and get converted into sugars

(Paul *et al.*, 2010). Also, the level of acidity in immature fig fruits might be higher than that in the mature fruits (Widodo, *et al.*, 1995). Therefore, acidity had to be determined. Acid value is defined as the number of milligrams of Potassium hydroxide required to neutralize the free fatty acids present in one gram of sample. The results in figure (1) showed that there was a rise in the acid values in all the samples under study compared to the control sample of minced green figs. For the MFO samples, acid value was increased with the increasing in the percentage of added pickled onions. On the other hand, there was a higher significant acid value decrement occurred with the MFL samples, as the acid values decreased with the increasing in the amount of pickled lemon proportion added, but the acidity values of MFL samples still significantly higher than both MFC and MFO samples.

Jadhav *et al.,* (2022) reported that acidity of lemon pickle was 4.21 at initial stage and increase to 5.57% during storage period. Roberts and Kidd (2005), who reported the pH of the fermented onion was between 3.25 and 3.35. Also, Kharat *et al.,* (2016) illustrate that pickles were high in acid content. Christian (2015) recommended that lemon juice or citric acid must be added to fig processed in a boiling water canner to keep them safe from botulism risk, that was due to figs naturally range in pH right around 4.6, which make them a borderline acid/low acid food since the pH can go above 4.6.

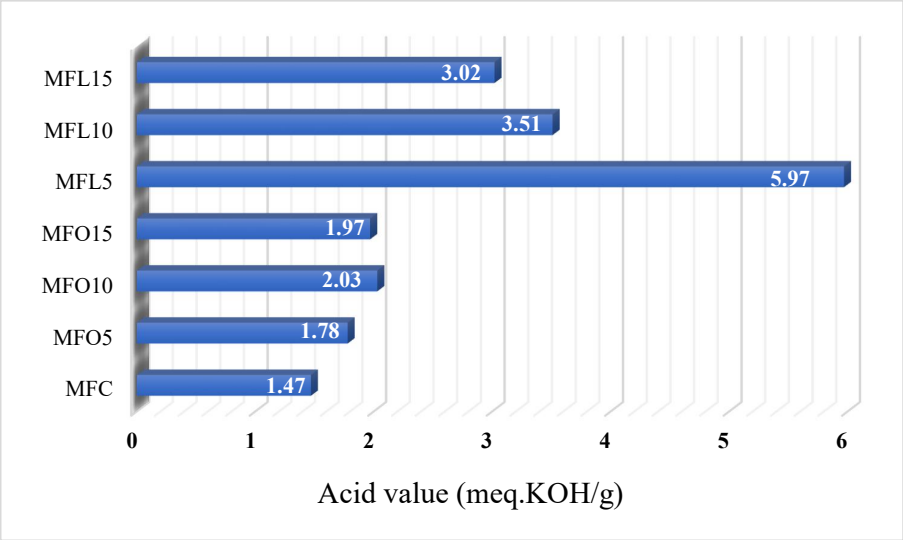

Fig. 1: Acid values of minced green fig samples.

3.4. Consistency of minced green fig samples:

Consistency is an important parameter to determine food product quality, it refers to uniformity or compatibility between things or parts of the food product. Figure (2) clarified the consistency of MF samples. Data demonstrated that, by adding pickled onion and pickled lemon to minced green fig caused a consistency decrement compared to MFC sample. Moreover, it was noticed that the consistency decreased as the percentages of pickled onion and pickled lemon increase. Consistency relates to 'thickness' so, the meaning of lower consistency, which observed with MFO and MFL samples, is the good ability for spread. Our results were higher than those obtained by Shokry, (2017) who found that consistency of control minced olive spread paste was (8419 cP), also, Escudero-Gilete *et al.,* (2009) demonstrate that olive paste was a preferred olive product due to its good moist and spread ability.

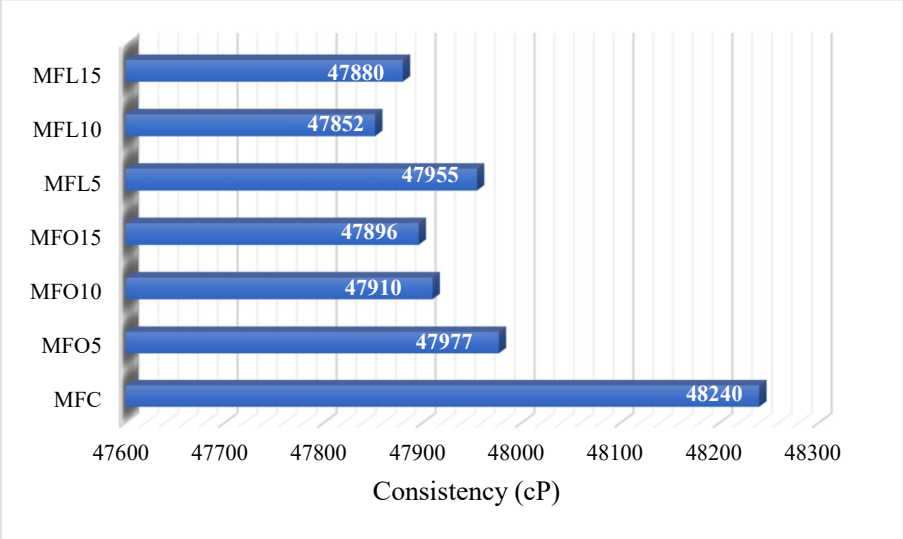

Fig. 2: Consistency values of minced green fig samples.

3.5. Total phenolic compounds of minced green fig samples:

There was an increasing interest about the phenolic compounds which naturally found in plants because of their antioxidant power. Consumption of food rich with a high level of such compounds may reduce the danger of some chronic diseases such as cancer and heart disease (Maria de Lourdes Reis Giada, 2013).

Figure (3) showed the values of total phenolic compounds in MF samples and the following was noted, the total phenolic compounds content of the MFC sample was 17 mg/100 gallic acid. Furthermore, adding pickled onion and pickled lemon to the MF sample enhanced the total phenolic compounds content, where the total phenolic compounds content increased as the percentages of pickled onion and pickled lemon increased.

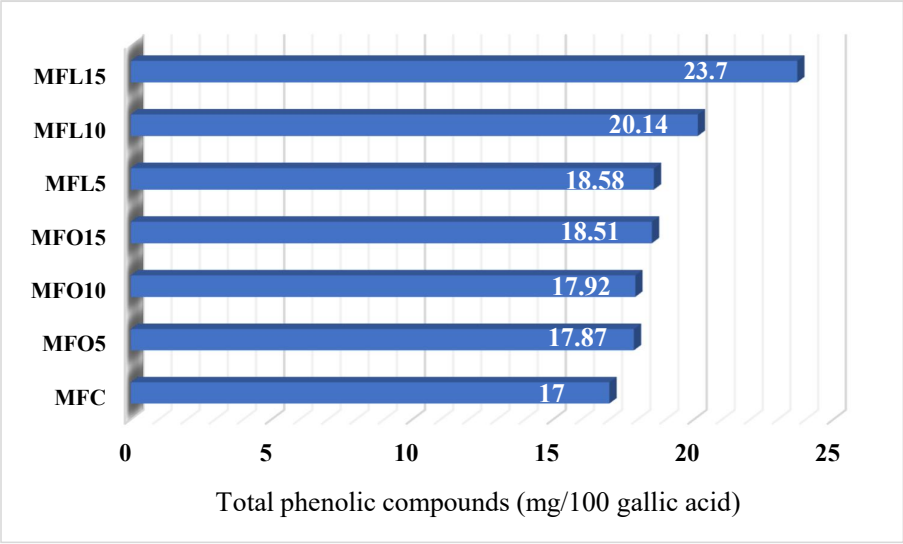

Fig. 3: Total phenolic compound values of minced green fig samples.

Also, it was also noticed that, the rate of increment in total phenolic compounds content for the MFL samples were higher than the rate of increment in total phenolic compounds content for the MFO samples. The total phenolic compounds content of the MFL5, MFL10 and MFL15 were 18.58, 20.14 and 23.7 mg/100 gallic acid, whilst, the total phenolic compounds content of the MOL5, MOL10 and

MOL15 were 17.87, 17.92 and 18.51 mg/100 gallic acid, respectively. As well as, figure (3) showed that, the total phenolic compounds content found in the MFO15 (18.51mg/100 gallic acid) sample was almost equal to the total phenolic compounds content for the MFL5 (18.58 mg/100 gallic acid). So, our data clarify that, both pickled onion and pickled lemon reinforcement the total phenolic compounds content of the minced green fig, but, pickled lemon found to be more powerful than pickled onion in supporting the minced green fig product with more total phenolic compounds content.

Arvaniti *et al.,* (2019) informed that the antioxidant capacity of figs is highly correlated with their phenolic compounds content. Also, Wiśniewska (2015) observed that total phenolic compound content in mild onion pickles in brine was 5.39 mg/100g. Sayın *et al.,* (2015) reported that, pickling process is relatively a good method for the preservation of phenolic acids in vegetables. Rafiq *et al.* (2018) found that citrus peel considered to be an excellent source of phenolic compounds and flavonoids.

3.6. Antioxidant activity of minced green fig samples:

The DPPH radical scavenging activity assay is a method used for determine the potential antioxidant capacity in foods products as indicator protection against oxidative damage (Halliwell, 1997). DPPH activity values of minced green fig samples were estimated and presented in figure (4) which clarify that, adding both pickled onion and pickled lemon to the minced green fig strengthen the DPPH activity, as the percentages of both pickled onion and pickled lemon increased the DPPH values increase. Also, it was noticed that, the rate of increment in DPPH values for the MFO samples were significantly higher than the rate of increment for the MFL samples.

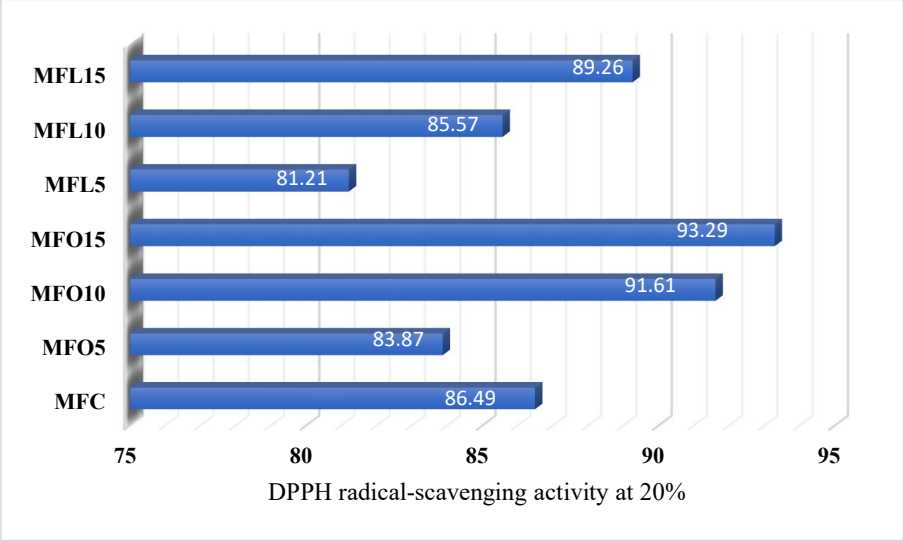

Fig. 4: DPPH values of minced green fig samples.

Aljane *et al.,* (2020) reported that, fig fruits are a good and valuable source of natural antioxidants that can be used in food and medical sectors. Vallejo *et al.*, (2012) and Bachir and Louaileche (2015) mentioned that ripening stage fig fruit is a parameter affected total polyphenols contents. Kaur *et al.,* (2016) reported that onion was a good source of antioxidants and its methanol extract has a higher scavenging activity and recommend in increasing using onion in human consumption. Although, Diab, (2016) and Makni *et al.,* (2018) illustrated that lemon is rich in phenolic compounds and possesses antioxidation properties, where Eshra *et al.,* (2020) demonstrated that lemon peel had a good DPPH scavenging activity. Moreover, Oroian and Escriche, (2015) announced that the antioxidant activity potent of citrus peels could be attributed to their high content of phenolic compounds. So, using pickled onion or pickled lemon with minced green fig enhanced the DPPH radical scavenging activity and thus, support the minced green fig as a new food product with a good antioxidant property which promote human health.

3.7. Sensory evaluation of minced green fig samples

Data in table (3) show the sensory evaluation of minced green fig samples. The data indicated that, by adding pickled lemon and pickled onion reinforcement taste, flavor and color of the minced green fig. Sensory score values of taste, flavor and color for MFL and MFO samples ranged between 8.0 to 9.0, which mean that, both pickled lemon and pickled onion could be used in preparing such product. The highest significant overall acceptability was observed with the MFL samples followed by MFO15 sample, where the MFC sample found to had the lowest overall acceptability. Roberts and Kidd (2005) mentioned that, sour onion had acidic taste with onion flavor but without the pungency of raw onions. Khaskheli *et al.,* (2017) attributes the lowest sensory attributes of the control pickle sample to the blanching during processing which cause ultrastructural changes.

Table 3: Sensory evaluation of minced green fig samples.

Minced green fig samples	Sensory parameters				
	Color	Texture	Taste	Flavor	Overall acceptability
MFC	$7.00^{b}\pm0.89$	$7.67^{b}\pm0.52$	$8.00^{a}\pm0.89$	$7.33^{b}\pm1.03$	$7.67^{b}\pm0.51$
MFO5	$8.00^{b}\pm0.89$	$7.33^{c}\pm0.52$	$8.33^{a}\pm1.36$	$8.00^{b}\pm1.54$	$8.33^{b}\pm1.03$
MFO10	$8.00^{b}\pm0.89$	$7.33^{c}\pm0.52$	$8.33^{a}\pm1.36$	$8.00^{b}\pm0.89$	$8.00^{b}\pm0.00$
MFO15	$9.00^{a}\pm0.00$	$8.33^{a}\pm0.52$	$8.33^{a}\pm1.36$	$8.67^{a}\pm0.51$	$8.67^{a}\pm0.51$
MFL10	$8.33^{b}\pm1.03$	$8.00^{a}\pm0.00$	$9.00^{a}\pm0.98$	$9.00^{a}\pm0.89$	$8.67^{a}\pm0.51$
MFL5	$8.00^{a}\pm0.89$	$8.67^{a}\pm1.03$	$9.00^{a}\pm0.98$	$8.67^{a}\pm0.51$	$9.33^{a}\pm0.51$
MFL15	$8.33^{a}\pm0.51$	$8.33^{a}\pm0.52$	$9.00^{a}\pm0.98$	$9.00^{a}\pm0.89$	$9.33^{a}\pm0.51$

(MFC) control minced green fig, (MFO5) minced green fig with 5% pickled onion, ((MFO10) minced green fig with 10% pickled onion, (MFO15) minced green fig with 15% pickled onion, (MFL5) minced green fig with 5% pickled lemon, (MFL10) minced green fig with 10% pickled lemon, (MFL15) minced green fig with 15% pickled lemon. Mean value ± Standard deviation of three replicates, means sharing the same letter in the same column are not significantly different at $p\geq0.05$.

4. Conclusion:

From the above results, it was found that usage of both pickled lemon and pickled onion enhanced the quality attributes of minced green fig which represented in crude fibers, ash content, total carbohydrates, total phenolic compounds, antioxidant activity, color with a good taste and high overall acceptability. Thus, unrip green fig could be processed in a minced green fig with pickled lemon and pickled onion to produce new functional. More study should be done in order to transform minced green fig into a product traded in the markets.

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